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Five new species of Viola from the South

EZRA BRAINERD

(WITH PLATES 34 AND 35)

I wish to report some results of my study of our southern violets during the past four years. This has consisted of field work during March and April of these years in portions of each of the eleven states covered by Dr. Small's Flora, and in the culture in my home garden of all known species and varieties of this region. My work has been greatly furthered by the kind assistance of many collectors and students of the genus, to whom I would acknowledge my grateful indebtedness, and to some of whom I allude personally in the following report.

The five new species that I describe in the present paper have been observed for at least two seasons, as they have developed from the seed to the mature plant. The first is from Florida, and is allied to *Viola Langloisii* Greene of southern Louisiana and Texas.

Viola chalcosperma sp. nov.

Plant glabrous, heterophyllous; leaves at the beginning and at the close of the season's growth uncut, the former cordate, 2–3 cm. long, the latter truncate at the base, broadly deltoid, 4–5 cm. long; vernal leaves cordate, 3-lobed, the middle lobe ovate, acute, the lateral more or less incised; flowers small, lilac-purple, raised above the leaves on slender peduncles; lateral petals bearded, odd petal sparsely villous, all finely purple-veined; cleistogamous flowers sagittate, on ascending peduncles; capsule gray, tinged with purple at base, ellipsoidal, about 11 mm. long, 5 mm. thick; persistent sepals purplish, lanceolate, 5 mm. long; auricles 3–4

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mm. long, the three outer with one or more sharp teeth; seeds the color of old bronze, 1.5 mm. long, about 50 in a capsule.—In wet soil in a wooded ravine, Jacksonville, Florida; the only known station.

This plant was first called to my attention by Miss A. M. Ryon, of New London, Conn., who sent living specimens in the summer of 1907, collected the preceding March at Jacksonville, Fla., by Mrs. E. K. Comstock. Numerous plants were raised from seed the following season and seemed to represent an unrecognized species. On a trip to Florida in March 1909, guided by Mrs. Comstock's precise directions, I readily found her station. The plants were abundant, and collections were made on March 21 and on April 9, which will soon be distributed.

The four following belong to the group represented by *Viola palmata* and *V. papilionacea*, and marked by ovoid cleistogamous flowers on prostrate, usually short, peduncles.

Viola floridana sp. nov.

Leaves at time of petaliferous flowering on spreading petioles, cordate, acute, finely crenate-serrate, often somewhat puberulent above, 2–3 cm. wide, 3–4 cm. long, leaves twice as long and wide appearing soon after, on long erect petioles, glabrate, sometimes persisting through the winter; corolla whitish or pale violet, on peduncles much surpassing the leaves, the odd petal glabrous; apetalous flowers under soil or dead leaves, narrowly ovoid-acuminate; their ripe capsules blotched with purple, trigonous-cylindric, about 16 mm. long, 7 mm. thick, on decumbent peduncles; sepals broadly lanceolate, about one third the length of capsule; seeds 2 mm. long, salmon-colored or dark brown, about 60 in a capsule.—Moist rich woodland, northern and central Florida.

This I first collected March 13, 1907, near Jacksonville, Fla., on an embankment for a street railway across a little marsh near Woodlawn Cemetery. Plants sent home at that time, or their offspring, have since been growing in the Middlebury garden. In March and April, 1909, I found the plant in several other stations near Jacksonville, and at stations widely separated in Volusia County—near the famous DeLeon Spring, on the shores of Lake Beresford, in an orange grove on a shell island near the outlet of this lake, on the edge of a tilled field near Lake Munroe, and in moist woodland near Deep Creek. In flower and fruit it

resembles *V. esculenta*, but its constantly uncut leaves on erect petioles and its habitat in well drained soil seem to mark it as distinct. *V. esculenta* was not found in Volusia County.

Viola rosacea sp. nov.

Acaulescent; leaves at vernal flowering narrowly ovate-cordate, acute or acuminate, crenate-serrate, 2–4 cm. long, sparsely hirtellous above; later leaves broadly ovate, subcordate, acuminate, glabrous, 5–7 cm. long; corolla rose-purple, about 2 cm. broad, spurred petal glabrous or slightly villous; cleistogamous flowers ovoid, on prostrate peduncles; their mature capsules ellipsoid, about 12 mm. long, 6 mm. thick, purple-dotted, enclosed for half their length in lanceolate sepals; the auricles of the three outer sepals short, appressed, entire, rounded; seeds buff, 2 mm. long, about 50 in a capsule.—Dry open woodland, Point St. Martin, near Biloxi, Mississippi; well drained borders of bayous, Crowley, Louisiana.

I first observed this species March 19, 1908, in a grove of deciduous trees on the fair-ground at Crowley, La. On the low, often flooded, borders of the neighboring bayou, *V. Langloisii* grew in profusion; but *V. rosacea* was confined to stretches of woodland above the flood-plain. I afterward collected it in similar situations in adjacent townships. The plant even at that early date was out of flower, with leaves and capsules nearly mature. Moreover, live plants shipped to Vermont failed to furnish flowers the following spring. Last March on my way South Dr. Small showed me a puzzling specimen of *Viola* collected by Professor S. M. Tracy at "Point St. Martin," Miss., March 10, 1898, *no. 5008*. A few days later I had the great pleasure of enjoying Professor Tracy's hospitality at his beautiful home on the north shore of the Bay of Biloxi, and of learning that the station for his *5008* was on his own premises, that in fact the violet was then in flower on the grounds in front of his house. In the early morning we examined the plant. The flowers were beautifully rose-colored, a feature quite unusual in the genus. A mist of dew on the foliage brought out strikingly the minute stiff pubescence of the upper surface of the leaves. This and the Crowley plant proved to be identical. A half dozen vigorous specimens from each locality have the past summer been growing side by side in the Vermont garden.

Viola Lovelliana sp. nov.

Plant often minutely hoary-pubescent on the upper part of the petiole and the adjacent lower surface of the blade, the pubescence elsewhere sparse and obscure; leaves cordate at base, earliest often uncut, later ones hastately 3-lobed, the middle lobe much the longest, lanceolate, sometimes contracted at the base and undulately serrate, the lateral lobes divaricate, either lunate or variously 2–3-cleft; leaves at petaliferous flowering 2–5 cm. long, those of late summer twice as long, often less deeply cut, or uncut; flowers violet-purple, on petioles often taller than the leaves, the three lower petals villous at the throat and marked with dark purple lines; cleistogamous flowers and immature fruit on prostrate peduncles; ripe capsules purple-dotted, trigonous-ellipsoid, about 14 mm. long, 7 mm. thick; sepals broadly lanceolate, acute, one third the length of capsule; auricles short, appressed, rounded, sparsely ciliate; seeds buff, 2 mm. long.—Sparsely wooded hillsides and knolls; from southern Louisiana to eastern Oklahoma.

Live plants of this, as an unknown species, were sent me in March, 1906, by Mrs. Phoebe Lovell, of Crowley, La. The plants did well in the garden; and mature leaves and fruit from cleistogamous flowers were obtained the following August, and petaliferous flowers in the spring of 1907. On my southern journey in March, 1908, I visited the station, a recent pine-chopping on loamy clay, more or less broken by low ravines. Four additional live plants were shipped home, and from each of these, and from their seedlings in 1909, many specimens were made of the mature plant.

The species turns out to be a common one in the western portion of the territory covered by Dr. Small's Flora. In April, 1908, I collected it in open woodlands near Muskogee, Okla., a mile from the Arkansas River; also, in the same state, under dwarf oaks on the slopes of a rocky hill at Eufaula, and in the vicinity of Stigler. In March, 1910, I obtained beautiful specimens at Mansfield, La., in a piece of woodland cut up by deep ravines; and also at Mena, Ark. I have in addition to these specimens one from Texarkana, Ark., "Pine woods, April 6, 1905, *B. F. Bush, no. 2237.*"

Viola Egglestonii sp. nov.

Plant acaulescent, of spreading habit, especially when young; leaves truncate at base, often flabellately decurrent, rarely subcordate; early leaves simply 3–5 lobed, later ones 3-parted, with

the middle or all three primary segments 2–3-cleft, the divisions oblanceolate or linear, crenately serrate toward the summit and bearing a few long narrow teeth below, the central division much the widest; flowers violet-purple, lateral petals bearded at the throat, spurred petal somewhat villous; cleistogamous flowers and fruit on short underground peduncles till seeds ripen; capsules green, turning gray, broadly ellipsoid, about 8 mm. wide and 13 mm. long, with lanceolate sepals one third as long; their auricles short, appressed, the three outer dentate; seeds brown, 2.5 mm. long. (PLATES 34 and 35)—Limestone barrens, West Nashville, Tennessee, *W. W. Eggleston, no. 4421*, May 26, 1909, type. Flowers and mature fruit and leaves observed from plants transferred to garden at Middlebury, Vermont.

This species is so distinct that at first sight of the growing plant one might not suspect to what known violets it was nearest of kin. It is a vigorous plant under cultivation. In the early stages of its growth the leaves spread out horizontally in all directions, and the roots penetrate deeply into the soil. In midsummer, when cespitose, the leaves are most of them erect and long-petioled. I know of no violet whose cleistogamous flowers and fruit are more thoroughly concealed under the soil; and as a result the capsules are rarely eaten into by beetles, often troublesome pests when one is endeavoring to collect violet seeds. Only a day or two before its seeds ripen does this unique species extrude its round green capsule from the ground, and lift it erect from its nodding position on the peduncle. Then after an hour or two of fair weather the three broad valves open widely, disclosing its large brown seeds; and in another hour, by the contraction of the thin sides of the valves, the seeds are pinched out and flirted in all directions.

This violet has as yet been found at one station only. But it may be expected to appear, to the collector who is looking for it, in many other of the extensive limestone barrens of Tennessee, and of northern Alabama and Georgia.

The types of the five species described in the present paper will be deposited in the herbarium of the New York Botanical Garden.

MIDDLEBURY, VERMONT.

Explanation of plates 34 and 35

PLATE 34

Viola Egglestonii Brainerd, natural size. Specimen collected at West Nashville, Tennessee, by W. W. Eggleston, May 26, 1909, *no. 4421*—type.

PLATE 35

Viola Egglestonii Brainerd. From three plants grown in the garden of E. Brainerd, Middlebury, Vt., transplanted from West Nashville, Tenn., May, 1909. A. Flowering specimen, May 10, 1910; $\times\frac{2}{3}$. B. A full-grown summer leaf, July 14, 1910; $\times\frac{2}{3}$. C. A mature capsule from cleistogamous flower, Oct. 1910; $\times\frac{1}{2}$.

Pollination experiments with Anonas

P. J. WESTER

Among the tropical and semi-tropical fruits that have found a congenial home in south Florida are the sugar apple, *Anona squamosa* L., the custard apple, *Anona reticulata* L., and the cherimoya, *Anona Cherimolia* Miller; one species, the pond apple, *Anona glabra* L., is indigenous. The sugar apple was introduced in 1833 by Dr. Henry Perrine, but whether the plants survived after his death in the massacre at Indian Key in 1840, and are the progenitors of the now naturalized plants of this species on the Florida Keys, or whether some of these are the offspring of a later unauthenticated introduction will probably never be known. It is probable that several separate introductions have been made from the Bahamas, where the species luxuriates and with which islands the early settlers on the Florida Keys were in intercommunication. Introductions have probably also been made from Cuba by way of Key West. The custard apple was probably introduced in a similar manner. The cherimoya referred to by Reasoner in Bull. No. 1, Div. of Pomology, U. S. Department of Agriculture, in 1887, is the custard apple, with which the cherimoya is very frequently confounded. The first authentic introduction of the cherimoya was made in 1895, when Mr. William Freeman brought seed to Little River from San José, Costa Rica.

The two first-named species have fruited fairly well in Florida, the sugar apple frequently coming into bearing the third year from the sowing of the seed; but only rarely do the trees bear abundantly. The failure of the cherimoya to set fruit after having bloomed for several years led the writer to begin investigations in 1907, in regard to the probable cause of the sterility of this species in Florida. From the construction of the flowers and their fragrance it became evident that they were entomophilous, and in the course of the observations it was discovered that they were proterogynous. After this discovery was made there was begun a comparative

study of the flowers and pollination of the sugar apple and the custard apple, the flowers of which superficially appeared to be identical with those of the cherimoya. It was then found that these two species were likewise proterogynous. In the course of this investigation it was noted that the flowers of the cherimoya and the custard apple shed their pollen in the afternoon from about 3.30 to 6 P.M. In the sugar apple the pollen is discharged in the morning from the rising of the sun to about 9 A.M., when practically all the pollen is shed. After examinations of a large number of trees of this species three were found to shed their pollen in the afternoon and the interesting fact was noted that this phenomenon does not occur on the same trees in the morning. A more limited number of trees of the custard apple and the cherimoya were available for observation; were it extended to a large number it is quite probable that individual trees may be found that shed their pollen at other times of the day than has been noted in the course of these observations.

The flowers of the three species enumerated, belonging to the section *Attae* Martius, are nodding; the calyx is tripartite, the sepals small and triangular; the six petals are arranged in two rows, the three exterior ones being linear-oblong with an obtuse sometimes acute apex; outside, these petals are ferruginous-tomentose and velvety in the cherimoya, while in the custard apple and the sugar apple they are greenish and sparsely hairy. The petals are shortest in the custard apple, being sometimes only 16 mm. long; in the cherimoya they frequently exceed 30 mm. in length. In all species they are keeled inside, whitish, concave, with a maroon blotch in the cavity, at the base; the interior petals are rudimentary; the number of stamens, which are attached to the torus, is indefinite and they cohere by a connective gland beyond the anthers, surrounding the syncarpium in which an indefinite number of carpids are united. As the flowers become full grown a viscid fluid is secreted that covers the syncarpium and which appears to be most abundant about twenty-four hours before the pollen is shed.

Until the shedding of the pollen the petals assume an almost perpendicular position (see FIGURES 1 and 3*a*) and leave a small opening, facing downward, for the entrance of pollen-bearing

insects.* (In individual trees of the cherimoya the apical end of of the petal is curved outward, though not to the extent of facilitating the conveyance of pollen to the stigma.) As the time approaches for the discharge of the pollen, the petals spread out and upward so rapidly that the movement is readily perceived; this phenomenon is accompanied by the exhalation from the flower of a fragrance analogous to that of a well-ripened banana

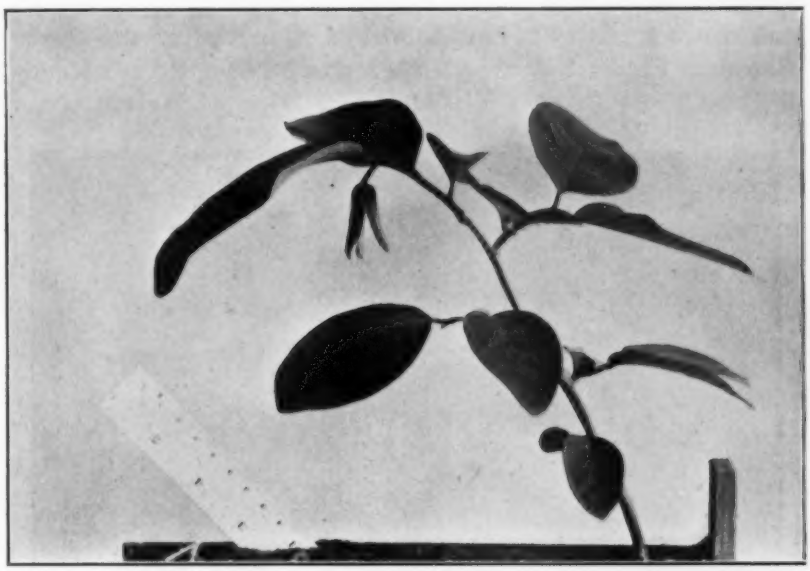

FIGURE 1. Flower of the cherimoya, showing position of petals when the stigmas are in the receptive state. (One third natural size.)

or pineapple in the cherimoya and custard apple; in the sugar apple it partakes of the odor of ethyl acetate and continues for a few hours until the pollen is shed, after which it disappears and the petals wither. The fragrance is also noticeable in the flowers twenty-four hours previous to the shedding of the pollen and is undoubtedly intended to serve as a guide for insects that aid in the pollination. The stigma is now readily approached by large as well as small insects and were the stamens and stigmas synchronous self-pollination by insects or the wind might be effected (FIGURES 2 and 3*b*).

*This expression is used advisedly, as it is very evident that the flowers are not constructed for wind pollination nor are self-pollinized, as will appear presently.

Owing to the advanced season of the year when the investigation began, with the consequent scarcity of bloom, extensive observations must perforce be suspended until the advent of the flowering season of another year. A small beetle, identified by Dr. C. L. Marlatt, assistant chief of the Bureau of Entomology as *Colastus truncatus*, was then found acting as pollinating agent in considerable numbers in the flowers of the sugar apple. This spring (1910) I found the same insect in flowers of the cherimoya and sent a specimen of this as well as of another species to the Bureau of Entomology for identification. The latter was identified by Prof. F. H. Chittenden as "*Triphleps*, probably *in-*

FIGURE 2. The same flower as in Figure 1, 24 hours later, showing position of petals when the pollen is discharged. (One third natural size.)

sidiosus." As this specimen is the only one of this species so far discovered, its presence in the flower may have been accidental. Another small beetle was found in the flowers of the sugar apple and sent to Dr. Marlatt for identification in 1908, who transmitted to me the following notes, by Mr. E. A. Schwarz, in regard to this species:

"The small brownish beetle has for a number of years been represented in our collection, but belongs to a family of Coleoptera which has been very little studied so far, the genus of which has never been determined. As near as we can say it belongs to the group *Pharaxonothi*. Many years ago the species was found by

the late Mr.H. G. Hubbard, an assistant of the Bureau, and he made some interesting observations on it at Crescent City, Florida. The larvae were found by him feeding upon the substance of the flower stems of both male and female cones of the coontie plant, *Zamia integrifolia*, but in no way injuring the flower. Mr. Hubbard came to the conclusion that both the larvae and the imagos of this little beetle are intended to facilitate the fertilization of the plant. The same species was found by me in great numbers on the flowers of the Florida palmetto and no further notes have been taken by me. The species does not seem to occur in the West Indies, nor is anything similar reported from Central America. There are various genera of the family described from South America but whether or not this species is identical with any one of them can not be ascertained at present."

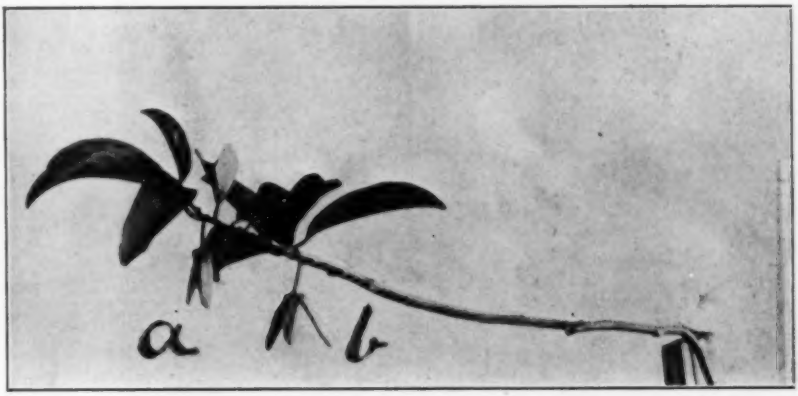

FIGURE 3. Flowers of the sugar apple; *a*, when the stigmas are receptive to the pollen; *b*, at the time of the discharge of the pollen. (One third natural size.)

In addition to these species a small thrips frequents the flowers of these Anonas and probably to some extent assists in their pollination.

In order to ascertain the validity of the theory of proterogyny in the Anonas in question a series of pollination experiments was inaugurated in 1908 on all three species, which was concluded this spring. In the course of this experiment on a cherimoya tree pollen was applied to the stigmas of twenty-seven flowers at the time of the discharge of the pollen in the flower, all of which dropped. The pollen was in some instances taken from the flower

pollinated, in others from other flowers of the same tree. In a few instances pollen of the sugar apple and the pond apple was applied. Thirty-four flowers were pollinated twenty-four or more hours before the shedding of the pollen and all set. Many of these dropped after partial development but the dissection of the

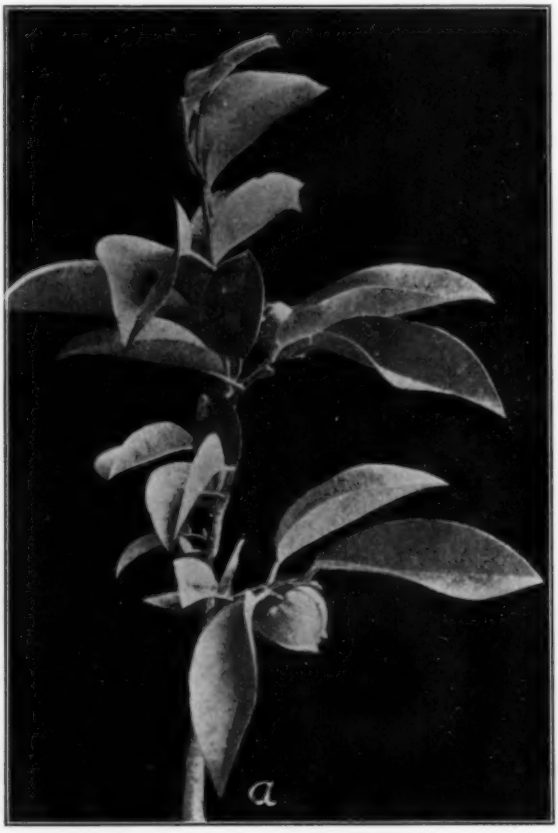

FIGURE 4. Pond apple flowers; a type introduced from Trinidad, B. W. I. (One third natural size.)

immature fruits showed that fertilization had taken place and that the drop was due to some other cause. In many instances it was undoubtedly due to overproduction, as the tree was too small to bring to full maturity all the fruits that set. Pollination of the flowers on the same tree in 1909, according to the theory of pro-

terogyny, produced another crop of fruits that year and the flowers responded likewise to pollination in the spring of 1910. Dr. A. Robertson Proschowsky, Nice, France, writes me that the results obtained by him in pollination experiments conducted on the cherimoya are analogous to those obtained by the author.

The plants of the sugar apple and the custard apple available for experimentation bore a larger number of flowers than the one cherimoya plant, and 143 flowers on one sugar apple tree were, in

FIGURE 5. Pond apple flowers; a type indigenous to South Florida. (One third natural size.)

April and May, 1908, pollinated with their own pollen or that of flowers of other plants of the same species, 41 with pollen of the cherimoya, 41 with pollen of the pond apple, and 51 flowers with pollen from the custard apple. In no instance did fruit set where the pollen was applied to the stigma simultaneously with the discharge of its pollen; practically all responded where it was applied fifteen to forty-eight hours previous

to this act, though here, as in the case of the cherimoya, the tree shed much of the fruit before it matured owing to its inability to carry it all. In September twenty-five pollinations of flowers on a sugar apple tree were made, in accordance with the theory of proterogyny, all successful. In order to verify the observations already made in regard to the pollinization and fertilization of the flowers of the species, over 100 flowers were pollinated on three trees in April and May, 1910, the results confirming the conclusions already made.

The pollination experiments with the custard apple in 1908 were conducted on three trees. In the course of these experiments 154 flowers, pollinated twenty-four hours before the discharge of the pollen in the flower, all, with few exceptions, set; 104 flowers, pollinated at the time of its discharge, all dropped.

The writer has in the course of his work with the Anonas in a very few instances noted that individual trees subjected to apparently the same conditions as others less fruitful were exceedingly prolific and from the results obtained in these investigations concluded that this was possibly due to synacmy and self-pollination. In order to obtain some information on this point with respect to the pond apple and to ascertain whether the pollination of the flowers of this species conformed to the same laws as those of its cultivated congeners, a series of experiments was carried through during April and May this year. Sixty-two flowers were bagged, in order to exclude all foreign pollen; none of these set. Fifty-six flowers were pollinated with pond apple pollen eighteen or more hours before the discharge of the pollen, and seven with pollen of the sugar apple and the cherimoya, with the result that sixty flowers were fecundated. The pollination of the flowers of this species thus appears to be analogous to that of its cultivated congeners.

The flowers of the pond apple, which belongs to the section *Guanabani* Martius, have six distinct, glabrous, concave, fleshy, outwardly yellowish white petals, in two series, the exterior being 25 to 40 mm. long, marked with red near the base inside, the interior smaller and red within except for a narrow transverse yellowish band near the base, the arrangements of the androecium and gynoecium being similar to those in the *Attae*. The flowers

open sufficiently twenty-four hours before the shedding of the pollen to admit the entrance of small insects to the stigmas. Practically all the flowers shed their pollen early in the morning before sunrise; only rarely has it been noted in the afternoon. This is accompanied by a strong, rather disagreeable odor and it is highly probable that the pollination is performed by nocturnal insects. There is no evidence that the pollination of this species is performed in the manner indicated by Morong in *Anona cornifolia* St. Hil., the construction of whose flowers is very similar, and the results obtained in the pollination work show that the pollen must be conveyed from one flower to another in a less advanced stage of development.

In this connection it is interesting to note that the observations on *Anona cornifolia* St. Hil. in Paraguay by Morong, to which my attention was directed a few months ago, led him to the conclusion that this species also is entomophilous.

"The stigmas lie . . . as far as I could judge entirely out of reach of the pollen by any action of the organs themselves. I found, however, that the pollen was very plentiful and that a pin thrust through the anthers obliquely would carry its grains to the stigmas. There seemed in the older flowers to be evidence that this operation is performed by insects, and I came to the conclusion that the plant must always depend for fructification upon insect agency."*

It would appear that Morong considered the stamens and pistils synchronous, although it is not evident that this conclusion was arrived at after investigation. That the flowers might have been dichogamous seemingly escaped him.

In the course of the pollination experiments of the cherimoya and custard apple a very interesting observation of the retardation of the development of a large number of fruits was made. Some cherimoya fruits developed without interruption from the time of pollination and matured in September, while a number remained stationary in size, about 8 mm. in diameter, until after July 25, when they suddenly began to increase in size and matured in October and November.

The flowering season of the custard apple begins in the latter

*Morong, T. Ann. N. Y. Acad. Sci. 7: 47. 1892.

half of May and continues throughout the summer and fall. Curiously enough, the flowers, which occur in great abundance, do not set until October and November, the fruit maturing in the spring. The pollination experiments with this species were started in May and continued during the following months. As already stated on a previous page, nearly all the pollinated flowers set, but with exceedingly few exceptions remained stationary in size, 6–8 mm. in diameter, until November, when they started to develop and matured in the usual season. The few fruits whose development began immediately after the pollination of the flowers matured in December.

The investigations indicate that the flowers of the cherimoya, the sugar apple, the custard apple, and the pond apple are proterogynous and entomophilous, though the pollinating agent of the last-named species has not been detected.

Since the investigations here related began, the cherimoya, after the trees have grown larger, has without artificial pollination, though sparingly, set fruit in Florida less than 20 feet above tide water. In California and Southern France it likewise fruits at a low altitude. In some parts of the world, *i. e.*, Hawaii, the species fruits only at an elevation of many hundred feet above the sea level. On investigation it may be found that this is due to the presence there of certain insects that do not occur at lower altitudes.

The sterility of the cherimoya in Florida has undoubtedly been due to the scarcity of blooms, which on this species is only one third of the number on the sugar apple, and to an insufficient number of insects to assist in the pollination of the flowers. As the trees grow larger and carry a greater number of flowers they may be expected to fruit more abundantly.

It has been demonstrated that the sugar apple hybridizes readily with the cherimoya, custard apple, and pond apple; the cherimoya has also been successfully crossed with the pond apple. So far, the attempts to cross the soursop, *Anona muricata* L., with the cherimoya, sugar apple, and custard apple have failed.

The extraordinary productivity of a few individual trees suggests a change in regard to the pollination of the flowers of these trees, possibly due to synacmy and self-pollination. Should

this hypothesis be confirmed on investigation, such trees would be of inestimable value for breeding work in the creation of varieties that are independent of outside agencies for fructification.

BUREAU OF PLANT INDUSTRY,
WASHINGTON, D. C.

Studies on the Rocky Mountain flora — XXIV

PER AXEL RYDBERG

Saussurea densa (Hook.) Rydb. sp. nov.

Saussurea alpina densa Hook. Fl. Bor.-Am. **1**: 303. 1833.
Saussurea alpina Ledebouri A. Gray, Syn. Fl. **1**^{2}: 397. 1884. Not *S. Ledebouri* Herder, 1810.

Saussurea Ledebouri Herder was based on *S. subsinuata*, *S. nuda*, and *S. Tilesii* of Ledebour, which Herder united into one species under another name. All three are illustrated in Ledebour's Icones Fl. Ross., and it is evident that *S. alpina densa* Hook. is different from each of them. None of the three illustrations shows the elongated, acuminate outer bracts, characteristic of *S. densa*. Only *S. nuda* shows a dense inflorescence with subsessile heads and a low stem, but the heads are fewer and less crowded, the stem is naked above, and the leaves entire.

S. densa is a plant of the higher mountains of the Canadian Rockies.

Saussurea remotiflora (Hook.) Rydb. sp. nov.

Saussurea alpina remotiflora Hook. Fl. Bor.-Am. **1**: 303. 1833.
Saussurea alpina A. Gray, Syn. Fl. **1**^{2}: 396, in part. 1884.
Saussurea nuda Britt. & Rydb. Bull. N. Y. Bot. Gard. **2**: 187. 1901. Not. *S. nuda* Ledeb. 1829.

This species is nearer to *Saussurea subsinuata* Ledeb. than to either *S. alpina* or *S. nuda*, but the inflorescence is laxer and the involucre is different, judging from Ledebour's illustration. *S. remotiflora* grows on low ground from northern Saskatchewan to Yukon and Alaska.

CARDUUS

So many species of thistles have lately been described from the Rocky Mountains that the number has more than doubled since the issue of Gray's Synoptical Flora. Some of these species should be reduced to synonymy and some of them are probably hybrids, but I think that the larger number will remain as good

species. It seems as if it should be unnecessary to propose more, but it has been impossible for me to include the following four in any known species.

Carduus polyphyllus sp. nov.

Carduus scopulorum Rydb. Mem. N. Y. Bot. Gard. **1**: 449. 1900.

Not *C. scopulorum* Greene. 1892.

Perennial; stem stout, 3–8 dm. high, very leafy, angled, arachnoid-hairy; leaves 1–2 dm. long, linear in outline, deeply pinnatifid, with lanceolate divisions ending in yellow spreading spines, green on both sides, sparingly arachnoid-hairy; heads hemispheric, about 3 cm. high and broad, usually numerous, sessile in the axils of the leaves, often forming a leafy spike 2–3 dm. long; bracts linear-subulate, densely arachnoid-hairy, the outer with rather long yellow spines often 1 cm. long, the inner attenuate into slender straight tips; corollas straw-colored; pappus plumose with slender, barbellate tips.

In my Flora of Montana, I referred this species to *Carduus scopulorum* Greene. The latter was based on *Cnicus eriocephalus* or *Cirsium eriocephalum* A. Gray, the type of which was collected by Parry in Colorado. The rather common Colorado plant is characterized by its leaves, which are grayish-tomentose beneath, and by its heads conglomerate at the end of the stem, forming a cluster which at first is nodding. *Carduus polyphyllus* is more closely related to *C. Kelseyi* and *C. Tweedyi*. From the latter it differs in the straw-colored instead of red corollas, the narrower bracts, and more numerous leaf-lobes, and from the former in the deeply dissected and decidedly crisp leaves. If the leaves are lobed at all in *C. Kelseyi* the spines are directed forward and the blades are almost perfectly flat.

MONTANA: Mountains near Indian Creek, July 21, 1897, *Rydberg & Bessey 5216* (type, in herb. N. Y. Bot. Gard.); Park Co., Aug., 1887, *Tweedy 349*.

Carduus Butleri sp. nov.

Perennial or biennial; stem angled, striate, purple, sparingly arachnoid-hairy, very leafy, 6–10 dm. high or more; leaves linear-oblanceolate or linear, almost entire or sinuately lobed, spinulose-ciliate and if lobed the short lobes ending in slightly stronger spines, green and sparingly arachnoid above, grayish-tomentose

beneath; heads few, ending the stem and short branches, subtended by narrowly linear spinulose-ciliate leaves, hemispheric, about 4 cm. high, 4–5 cm. wide; outer bracts lanceolate, brownish, glabrous or nearly so, ending in short weak spines 2–3 mm. long, the innermost linear-lanceolate, attenuate, ending in slender brownish or purplish somewhat twisted and spreading lance-linear tips, these neither dilated nor erose; corollas pinkish; pappus plumose; tips more or less clavate.

This species resembles *Carduus Kelseyi* and *C. foliosus* in the leaves, but differs from both in the scattered few heads and purplish stem. In both species mentioned, the heads are conglomerate at the end of the stem. In *Carduus Kelseyi* the involucral bracts are much narrower and decidedly arachnoid. In *C. foliosus* the bracts are somewhat broader than in *C. Butleri*, the inner ones have dilated, lanceolate and erose tips, and the leaves are usually more lobed.

MONTANA: Big Fork, July 28, 1908, *B. T. Butler, 674* (type, in herb. N. Y. Bot. Gard.); also near Rost Lake, *677*.

Carduus lacerus sp. nov.

Probably biennial; stem stout, 6–10 dm. high, sparingly arachnoid, angled and striate; lower leaves oblanceolate, 2–3 dm. long, pinnatifid, with rather broad, ovate or lanceolate divisions ending in weak spines, glabrous or slightly long-hairy and green above, grayish tomentose beneath; upper leaves lanceolate, sessile and clasping, with somewhat narrower lobes and rather stout spines; heads more or less clustered, about 4 cm. high and broad; outer bracts ovate-lanceolate, glabrous, without glutinous ridge, ending in short stout spreading spines 3–5 mm. long; inner bracts with dilated, ovate, abruptly acuminate, erose and crisp, spreading tips; corollas rose-colored; pappus plumose; tips slightly clavate.

This species was probably included in *Cnicus scariosus* by Gray, judging from his description in the Synoptical Flora; but it is not *Cirsium scariosum* Nutt., for Nuttall characterized the latter as having arachnoid-hairy involucres, the bracts with dilated erose tips, and the leaves tomentose beneath. I know of only one species which agrees with this characterization. This is well represented by *Flodman 880*, which was distributed as *Carduus Hookerianus*.

UTAH: Wahsatch County, near Midway, July 6, 1905, *Carlton*

& Garrett 6732 (type, in herb. N. Y. Bot. Gard.); apparently also, Salt Lake City, August, 1880, *M. E. Jones 1905*, and the same locality, Sept., 1905, *A. O. Garrett 1718*.

Carduus olivescens sp. nov.

Perennial; stem slender, somewhat tinged with purple, more or less floccose, 4–8 dm. high, leafy; leaves linear in outline, 1–2 dm. long, densely white-tomentose beneath, loosely floccose above, deeply pinnatifid, with numerous lanceolate, often 2- or 3-cleft lobes, ending in short yellow spines; heads few, peduncled, about 3 cm. high, 3–3.5 cm. wide; bracts slightly floccose on the margins, light olive-colored, darker towards the apex, ending in yellow spines 2–4 mm. long, or the innermost with lance-linear, slightly twisted yellowish tips; corollas straw-colored; pappus plumose; tips slightly clavate.

This species was first determined questionably as *Carduus Tracyi*, to which it is not closely related, not having the conspicuous broad glutinous dorsal ridges or the broad bracts of that species. In leaf-form it resembles somewhat *C. pulcherrimus*, although the upper surface is more floccose, but otherwise it is not close to that species.

UTAH: Aquarius Plateau, August 5, 1905, *Rydberg & Carlton 7450* (type, in herb. N. Y. Bot. Gard.).

Thistle hybrids are very common in Europe and even tertiary hybrids have been reported. No attempt has been made in this country to segregate or recognize hybrids in this genus. As a rule specimens of thistles are not so common in herbaria as would be expected, probably owing to the difficulty in collecting and preparing them.

Thistles are not uncommon in the Rocky Mountains, especially in Colorado. No person has perhaps contributed more to the knowledge of these plants of that state than Mr. George E. Osterhout, of New Windsor, Colorado. He has described a few species himself and others have been described from material collected by him. There are still more forms recognized by him and distributed under manuscript names, but which he has been reluctant to describe. With the aid of the material sent me by him, augmented by other specimens collected by Baker, Shear, Clements, myself, and others, it has been possible to recognize

a good many forms which I regard as hybrids. The two species which seem to have produced the most hybrids are *Carduus americanus* (A. Gray) Greene (not Rydb.) and *C. griseus* Rydb. The former of these is comparatively common in Colorado, but the latter is rather rare. Several of the specimens cited under the latter in my Flora of Colorado do not belong to it, but are hybrids of *Carduus americanus* and various species. The original of *C. griseus* and later specimens collected by Osterhout do not have the bracts dilated at all or erose; the spines of the involucral bracts are long and somewhat flattened, and the leaves are darker and less deeply divided than in *C. americanus*. The following probable hybrids have been recognized, but, like Mr. E. P. Bicknell, in the matter of *Rubus* hybrids,* we wish "to divest the subject from all nomenclatorial claims" and "to be understood merely as pointing out the probability of the occurrence of the hybrids mentioned."

CARDUUS AMERICANUS×GRISEUS

This has the leaves of *C. griseus*, *i. e.* dark green above, grayish-tomentose beneath and with short lobes, as well as the strong and broad spines of the involucral bracts of that species, and some of the outer bracts are spinulose-ciliate; but most of the bracts are erose on the margins and the inner ones have dilated tips as in *C. americanus*. The following specimens are to be referred here:

COLORADO: Toland, Gilpin Co., July 20, 1906, *Osterhout 3266;* Ward, Boulder Co., July 17, 1901, *Osterhout 2429*.

The former of these was labeled by Osterhout *Carduus erosus* Rydb. (?). The original *C. erosus* is quite different. To strengthen the probability of hybridity, it may be mentioned that Mr. Osterhout has sent in specimens of one of the supposed parents, viz., *C. griseus*, also from Toland, Gilpin Co., collected on the same date, his *3267*, the next number, and that *C. americanus* is a rather common plant in Colorado.

The latter of the two specimens was determined by me as *C. griseus*, although I now regard it as a hybrid of that species and *C. americanus*. *C. americanus* has been collected at Ward, by Tweedy.

* Bull. Torrey Club **37**: 399. 1910.

CARDUUS AMERICANUS×SPATHULATUS

This resembles most *C. americanus* in habit and leaf-form; the bracts are somewhat erose on the margins as in that species, but they are scarcely at all dilated, and if so only the innermost, and they are tipped with the short and broad spines characteristic of *C. spathulatus*. To this are referred:

COLORADO: Estes Park, Aug. 16, 1905, *Osterhout 3091;* Sulphur Springs, July 16, 1905, *Osterhout 3057;* Happy Hollow, July 14, 1898 (collector not given), Herb. State Agric. College, *no. 2801*.

The last was distributed as *Carduus griseus* and has perhaps given rise to a wrong impression of that species. *C. spathulatus* was then undescribed and the bracts excluded no. 2801 from *C. americanus*. We have no specimens of either of the supposed parents, from exactly the same locality, but *C. americanus* is found nearly everywhere in the mountains of northern Colorado, and Osterhout in the original description of *C. spathulatus* states that it is common on both sides of the range of mountains east of the North Park.

CARDUUS AMERICANUS×COLORADENSIS

Carduus erosus Rydb. Bull. Torrey Club **28**: 507. 1901.

This was originally described as a distinct species. Professor Nelson reduces it to a synonym of *Carduus americanus*. The broad hemispheric head, the broad bracts with less dilated tips, and the more spiny leaves with more numerous and lanceolate lobes are very different from those of the typical *C. americanus*. The form and structure of the involucre, the form of the leaves, and the habit approach those of *C. coloradensis*. The upper surface of the leaves and the midrib beneath show some of the arachnoid hairs characteristic of *C. coloradensis* and its allies. We have no specimens of the two supposed parents from Durango, the type locality of *C. erosus*, but the locality is not without the range of either.

COLORADO: Durango, 1896, *F. Tweedy 517*.

CARDUUS ACAULESCENS×AMERICANUS

This resembles most *C. americanus*, but the stem is lower, the heads crowded, the involucral bracts elongated and less dilated

at the tip, the leaves have more lanceolate lobes and stronger spines, and the stem and midribs of the leaves are more or less arachnoid-hairy. The clustered heads, the arachnoid pubescence on the stem, and almost glabrous bracts, with broad bases gradually tapering upwards, would suggest *C. acaulescens* as the other parent.

COLORADO: Plains and foothills near Boulder, July, 1903, *Tweedy 5852*.

CARDUUS ACAULESCENS×COLORADENSIS

Carduus acaulescens (A. Gray) Rydb. and *C. coloradensis* Rydb. are closely allied and many regard them as forms of the same species. As they often grow together and intermediate forms are found, this disposition seems plausible, but these intermediate forms may as well be explained by hybridity. The typical *C. acaulescens* has practically no stem and the small campanulate heads, seldom more than 3 cm. wide, are sessile and congregated in a flat-topped head-like cluster, while the typical *C. coloradensis* has a stem 3–10 dm. high and the larger heads are more or less peduncled, 4–7 cm. broad, hemispheric, and scattered. The intermediate forms are usually low-stemmed and the heads, intermediate in size and shape, are in a dense flat-topped cluster at the end of the stem. At the south end of Fish Lake, Utah., *C. acaulescens* and *C. coloradensis* were found together by myself and Mr. Carlton and the specimens in the New York Botanical Garden bear the numbers *7547* and *7546*, respectively. The supposed hybrid also was collected, although I can not find any specimens now in the collection of the New York Botanical Garden. They may have met the same fate as some other specimens of the collection in being damaged by rain. There is one specimen, however, in our herbarium, which I regard as belonging to this hybrid, viz.

COLORADO: Sulphur Springs, Grand Co., Aug. 8, 1907, *Osterhout 3615*.

CARDUUS ACAULESCENS×SCOPULORUM

Carduus crassus Osterhout, MS.

This was distributed under the manuscript name cited above and regarded by Osterhout as a distinct species. I am inclined

to think it a hybrid of the two species mentioned for the following reasons. The form and the pubescence of the leaves are almost exactly those of *Carduus acaulescens*. The small and clustered heads also suggest that species; but the plant has an evident stem and the involucre is decidedly arachnoid-hairy. As *C. scopulorum* and *C. Parryi* are the only species in Colorado which have arachnoid involucres, one of these may be supposed to be the other parent. As *C. Parryi* has also dilated erose bracts, it must be thrown out of consideration. In *C. crassus* the involucral bracts have also the long slender spines characteristic of *C. scopulorum*.

COLORADO: Sulphur Springs, Grand Co., July 17, 1905, *Osterhout 3042*.

Neither of the two supposed parents is represented by specimens from Sulphur Springs, but there is a specimen, *Osterhout 3615*, just cited above, which I regard as a hybrid of *C. acaulescens* with another species.

CARDUUS GRISEUS×LATERIFOLIUS

Carduus canalensis Osterhout, MS.

This I included in *Carduus griseus* in my Flora of Colorado but it differs in many respects from the type of that species, the leaves being much broader and less lobed, the upper leaves with broad auricles and the inner bracts with dilated erose tips. These two characters suggest *C. laterifolius*, from which it differs in the long and broad spines of the outer bracts, characteristic of *C. erosus*.

COLORADO: Canyon of Thompson River, Larimer County, August 16, 1905, *Osterhout 3089*.

This specimen was collected together with the type number of *C. laterifolius*, viz., *Osterhout 3090* (the next number).

CARDUUS GRISEUS×SCOPULORUM

Carduus Osterhoutii Rydb. Bull. Torrey Club **32**: 131. 1905.

This has the habit, the leaf form, and the long flat spines of the bracts of *Carduus griseus*, but the inflorescence is conspicuously arachnoid-hairy as in *C. scopulorum* and the leaf segments are rather more numerous than in *C. griseus*. The following specimens belong here:

COLORADO: Red Cliff, Eagle Co., July 17, 1902, *Osterhout* 2706; Tennessee Pass, July 28, 1902, *Osterhout 2640.*

The first of these specimens was associated with *Carduus griseus, Osterhout 2707* (the next number), collected at the same date and locality. *C. griseus* was collected at Red Cliff in 1906 also, *Osterhout 3362. C. scopulorum*, the other supposed parent, is rather common throughout the mountains of Colorado.

CARDUUS GRISEUS×PARRYI

Carduus araneosus Osterhout, Bull. Torrey Club **32**: 612. 1905.

Osterhout in the original description of *Carduus araneosus* suggests the relationship with *C. Parryi. C. araneosus* differs from that species mainly in the less greenish corollas, the stouter and broader spines of the bracts, and the grayish under surface of the leaves. These characters suggest *C. griseus*, but the involucral bracts are decidedly arachnoid-pubescent and the inner bracts are more or less dilated above and erose. The following specimens belong here:

COLORADO: Red Cliff, Eagle Co., June 26, 1900, *Osterhout 2169*; and also Aug. 16, 1906, *Osterhout 3363;* Boreas, July 24, 1897, *Crandall 2806;* without locality, *J. Wolf 459* (Wheeler Exp.).

The first two specimens were collected at Red Cliff, where also two numbers of *C. griseus* (see under preceding hybrid) and one of *C. Parryi*, viz., *Osterhout 2708*, were collected.

CARDUUS OREOPHILUS×SCOPULORUM

This resembles *C. scopulorum* in the heads crowded at the ends of the stem, the arachnoid involucres and general habit; but the leaves are broader, with fewer lobes; the involucral bracts are broader at the base, and the flower-cluster not nodding. In these characters it approaches *C. oreophilus*, but it has less deeply dissected leaves with broader lobes, and the inflorescence is much more arachnoid.

COLORADO: Silver Plume, Aug. 23, 1895, *Shear 4948* and *4960.*

Carduus oreophilus also was collected at Silver Plume the same day by Shear, *no. 3258*, and also by Rydberg on the following day. *C. scopulorum* is common in the upper part of Clear Creek above Silver Plume. In the herbarium of the Garden there is one speci-

men from near Gray's Peak, *Shear 4734*, collected on the same date as *4948* and *4960*.

CARDUUS COLORADENSIS×UNDULATUS

With the specimen cited below, Mr. Osterhout sent a slip of paper on which is written: "Do not think this is *Carduus undulatus*—do not know what it is." It resembles *C. undulatus*, the flowers being red, although paler, the bracts having a glandular dorsal ridge, and the general habit and leaf-form being similar, but the dorsal ridge is very inconspicuous. It resembles perhaps more *C. coloradensis* in habit, in the form of the bracts, and the lanceolate twisted tips of the innermost of these. There is also an indication of arachnoid hairs on the stem, but the corollas are pink, not dirty white, and there is an evident though narrow dorsal ridge towards the ends of the bracts.

COLORADO: Wolcott, Eagle Co., July 11, 1902, *Osterhout 2653*.

Mr. Osterhout collected also *C. coloradensis* at the same date and locality, viz., *2651*.

CARDUUS FILIPENDULUS×OCHROCENTRUS

Carduus dispersus Osterhout MS.

This has the large heads and the long spines of *C. ochrocentrus* but the broad non-decurrent leaves and dark green glabrate upper surfaces of *C. filipendulus*.

COLORADO: Home, Larimer Co., July 29, 1904, *Osterhout 2898*.

Both of the supposed parents are common in Larimer County. Mr. Osterhout doubts that this can be a hybrid between the two supposed parents given above, as he has not seen either growing so far up in the mountains.

CARDUUS FLODMANII×MEGACEPHALUS

This specimen cited below was determined as *Carduus Flodmanii*, but its leaves are much broader and with shorter and broader lobes, the heads are larger, and their bracts more glutinous than in the typical *C. Flodmanii*. The plant is almost exactly intermediate between that and *C. megacephalus*.

COLORADO: Fort Collins, July 30, 1904, *Osterhout 2903*.

Both of the supposed parents are common around Fort Collins.

CARDUUS PLATTENSIS×UNDULATUS

The specimen cited below was sent me by Mr. Osterhout, who suggested that it was a hybrid of *Carduus plattensis* Rydb. and *C. undulatus* Nutt. It has the head of the former, but somewhat smaller and with narrower and less viscid bracts. The leaves also are those of that species but approach those of *C. undulatus*.

COLORADO: Thompson's River, Larimer Co., Aug. 16, 1905, *Osterhout 3087*.

There are many features that suggest hybridity in *Carduus perplexans* Rydb. In the original description, attention was directed to its relationship to *C. Centaureae* (= *C. americanus* Greene) and also to the *C. altissimus* group. At that time I was inclined to regard it as a hybrid between *C. americanus* and *C. filipendulus*, but the broad leaves seemed to contradict such a disposition.

Since that time I have been inclined to regard it as a hybrid of *C. laterifolius* Osterhout and *C. filipendulus*, as the former has broad leaves resembling those of *C. perplexans*. The bracts, erose-tipped as they are, are not much like those of *C. laterifolius*. Mr. Osterhout suggests that it might be a hybrid of an undescribed species, specimens of which he has sent me. In these the bracts resemble those of *C. perplexans* very much and the flowers are also red; but the leaves are narrow and deeply pinnatifid. This species and *C. filipendulus* could scarcely produce a hybrid like *C. perplexans*.

All the supposed hybrids given above were collected in Colorado. Besides these the following are in the herbarium of the New York Botanical Garden from neighboring states.

CARDUUS MEGACEPHALUS×OCHROCENTRUS

There seem to be two rather distinct forms included in *Carduus ochrocentrus*. As both are found in Texas and New Mexico and I have not seen the type specimen, I am uncertain which of the two is *C. ochrocentrus* proper. One of them extends northward to Nebraska and northern Colorado and is the only one found within the range of my studies. For the present I regard this as *C. ochrocentrus*, until further information can be had. It is characterized by strongly decurrent and strongly spinose, crisp leaves.

with numerous short crowded lobes and densely white-tomentose beneath. The spines of the involucral bracts are also long and strong, in age usually strongly spreading. *C. megacephalus*, which resembles it in many respects, has much broader flatter leaves, with fewer lobes and short spines, scarcely decurrent and at least the upper ones with broad clasping bases. The spines of the involucres are also short and weak. The following two specimens have leaves resembling those of *C. ochrocentrus* but not decurrent and have involucral bracts with the short weak spines of *C. megacephalus*.

NEBRASKA: Banner County, July 6, 1891, *Rydberg 215a*.

KANSAS: Plains, Ellis County, July 16, 1895, *Hitchcock 309*.

The first of these was collected with *Carduus megacephalus*, *Rydberg 215*. *C. ochrocentrus* was common in the region. *Rydberg 214*, belonging here, was collected a few miles further south. There are also forms intermediate between *C. megacephalus* and *C. undulatus*, but as these two species are so closely related that it is almost impossible to draw a line between them, I have not tried to distinguish any hybrids.

CARDUUS FOLIOSUS×SCOPULORUM

This has the habit and bracts of *Carduus foliosus*, but the involucre is densely arachnoid as in *C. scopulorum* and the leaves have more numerous and crowded lobes, in that respect approaching those of the latter species.

WYOMING: Big Horn Mountains, Aug., 1899, *Tweedy 2120*.

Carduus scopulorum was evidently growing near it, for a specimen belonging to it and collected by Tweedy bears the number *2122*. *C. foliosus* is common in the Big Horn Mountains. Among others are *Tweedy 3051*, collected there the following year.

Carduus Tweedyi, judging from the scarcity of the plant and from the fact that it combines the characters of two groups, may also be a hybrid. A plant of its type may be produced by the crossing of *C. polyphyllus* and a red-flowered species such as *C. Macounii* or *C. edulis* but neither of these two has been found east of the continental divide and *C. Tweedyi* not west of it. A somewhat similar plant would be produced by the crossing of *C. scopulorum* and *C. Eatoni*, but I have seen no specimens of the latter outside of Utah.

CARDUUS BUTLERI×KELSEYI

The leaves of the two supposed parents are very similar, so the differences are mostly found in the inflorescence and the involucral bracts. See under the description of *Carduus Butleri*.

The supposed hybrid has the inflorescence of *C. Kelseyi*, the bracts of *C. Butleri*, but slightly arachnoid-hairy.

MONTANA: Rost Lake, July 28, 1908, *Butler 703*.

Carduus Butleri was collected at the same locality and on the same date, *Butler 677;* and *C. Kelseyi* three days later a little higher up in the mountains, *Butler 398*.

CARDUUS EATONI×OLIVESCENS

Cnicus Eatoni A. Gray included several forms. Three of these had been distinguished by D. C. Eaton, who, however, had applied wrong names for two of them. The first of the three Eatonian synonyms cited by Dr. Gray is *Cirsium eriocephalum* var. *leiocephalum*. Dr. Gray's description also applies principally to this. Hence *Carduus leiocephalus* (D. C. Eaton) Heller becomes a synonym. *Cirsium foliosum* D. C. Eaton, I think, is the same as *Carduus nevadensis* Greene and *C. Drummondii* D. C. Eaton is a Nevada plant, almost identical with *C. oreophilus* of Colorado.

The supposed hybrid under consideration resembles *C. Eatoni* in general habit, but the leaves have fewer and deeper lobes and are grayish tomentose beneath, and the involucres have shorter and weaker spines. It differs from *C. olivescens* in the broader segments of the leaves, the narrower bracts, of which the outer are spinulose-ciliate as in *C. Eatoni*.

UTAH: Aquarius Plateau, Aug. 4, 1905, *Rydberg & Carlton 7422*.

Carduus olivescens also grew on the Aquarius Plateau. The type of it was collected the following day and bears the number *7450*. *C. Eatoni* is common in the same region, although Carlton and myself did not preserve any specimens from the Aquarius Plateau.

CARDUUS PULCHELLUS×UNDULATUS

This most resembles *Carduus pulchellus* in habit, but the involucres are more hemispheric instead of truly campanulate, the bracts are broader and with a narrow glutinous ridge, and the inner

ones are not so elongated as in that species. From *C. undulatus* it differs in the narrower segments of the leaves, the glabrate upper surface of the same, the somewhat purple-tipped inner bracts, and the inconspicuous dorsal ridge.

UTAH: Fish Lake, near Twin Creeks, Aug. 8, 1905, *Rydberg & Carlton 7499* and *7487;* Beaver City, 1877, *Palmer 273.*

COLORADO: Grand Junction, June 15, 1900, *Mrs. Stokes.*

Neither of the supposed parents was collected at the same date and locality, but both are found in Utah and Colorado. *C. pulchellus* was collected by Carlton and myself in the neighborhood of Marysvale, *nos. 7016* and *7179.*

A good deal can be said about the treatment of this genus in the New Manual of Botany of the Central Rocky Mountains. Many of the species, reduced to synonymy, have little or no relationship to those of which they were made synonyms.

Under *Carduus americanus* we find the following synonyms: *C. Centaureae* Rydb., *C. erosus* Rydb., and *C. griseus* Rydb. The first is a pure synonym. When the name was proposed I was following the Madison amendments of the "Rochester Code," and according to those amendments an older varietal name invalidated the name *C. americanus. C. erosus* I now think is a hybrid of *C. americanus* and *C. coloradensis. C. griseus*, on the contrary, is a good species, easily distinct from *C. americanus*, and its bracts have no dilated erose tips. In my Flora of Colorado I included in it at least two hybrids of *C. americanus* with this species and related ones. This may have given Professor Nelson a wrong idea of *C. griseus.*

Under *Carduus Hookerianus* we find as a synonym *C. Osterhoutii. C. Hookerianus* is, so far as I know, not found within the United States. It is from the Saskatchewan region. I, as well as others, have referred specimens from Colorado to it, but all these belong to a form of *C. scopulorum.* This may have been the reason why Nelson has made the latter a variety of *C. Hookerianus* under the name *C. Hookerianus eriocephalus. C. Osterhoutii* is not closely related to *C. Hookerianus*, but more so to *C. scopulorum.* I think it is a hybrid of that species and *C. griseus.*

Under *Carduus Hookerianus eriocephalus* we find the follow-

ing synonyms: "*Cnicus eriocephalus* Gray, *Carduus scopulorum* Greene l. c., *C. Tweedyi* Rydb. l. c., *C. araneosus* Osterh. * * * *C. Eatonii* Gray, * * * *C. canovirens* Rydb. l. c. (?) *C. pulcherrimus* Rydb." Of these the two first are pure synonyms. *Carduus Tweedyi* is a related red-flowered species (see page 552). *C. Eatoni*, as I understand it and limited to *C. eriocephalus* var. *leiocephalus* D. C. Eaton, is a good species, forming a group by itself. *C. araneosus* is not related to *C. scopulorum* but to *C. Parryi*, as Osterhout suggested, and is probably a hybrid of that species and *C. erosus*. *C. canovirens* and *C. pulcherrimus* do not belong even near *C. scopulorum*, but to the *C. undulatus* group. *C. canovirens* has no very close relative. The nearest is perhaps *C. canescens* (Nutt.). Nelson once thought it a good species, distributed it under a manuscript name, and would have published it, if his attention had not been called to the fact that it was already published. *C. pulcherrimus* is most closely related to *C. ochrocentrus* and stands to that species nearly in the same relationship as *C. undulatus* does to *C. megacephalus*.

Under *Carduus foliosus* are found the following synonyms: *C. scariosus* (Nutt.) Heller and *C. coloradensis* Rydb. Judging from Nuttall's original description of *Cirsium scariosum*, it is not at all related to *Carduus foliosus* Hook. See remarks above under *C. lacerus*. *Carduus coloradensis* is not to be referred to *C. foliosus*. It was based mainly on *Cnicus Drummondii* of the Synoptical Flora, and is apparently the same as *Carduus Drummondii* of the New Manual, the corolla of which is described as white. The original *Cirsium Drummondii* T. & G., of which there is a duplicate in the Torrey herbarium, has rose-purple corollas. The only specimens I have seen from the United States, are from the Black Hills of South Dakota. All the others are from British America.

Carduus oreophilus Rydb. is given as a synonym under *C. Drummondii*. From what is just stated it may be seen that it is not the original *C. Drummondii* and a comparison between my description in the Bulletin of the Torrey Botanical Club and that of *C. Drummondii* in the New Manual shows that it is not *C. Drummondii* as understood by Professor Nelson. *C. oreophilus* is very local and many things suggest a hybrid, but I have failed

to find two species that would produce a combination of characters found in *C. oreophilus*. A mixture of four species, *C. pulchellus*, *C. spathulatus*, *C. scopulorum* and *C. coloradensis* might do it. I think therefore that it is best to regard it at present as distinct.

Under *Carduus bipinnatus* (Eastw.) Heller, in the New Manual, we find: *C. pulchella*[*us*], *C. truncatus* Greene(?) and *C. spathulatus* Osterh. The only true synonym is *C. truncatus* Greene. *C. pulchellus* is related to it, but the leaves are white-tomentose beneath. *C. spathulatus* Osterhout is related to *C. griseus*, though its involucral bracts are much shorter. The plant resembles closely *C. americanus*, but the bracts are not at all fimbriate.

Carduus Tracyi Rydb. is, in the New Manual, made a synonym of *C. Nelsonii* Pammel (Pammel did not use the generic name *Carduus* and the page is wrongly cited), while the latter is kept distinct from *C. plattensis* Rydb.

A botanist with broad limitations of species might regard *Carduus plattensis*, *C. Nelsonii*, *C. Tracyi*, *C. brevifolius*, and *C. palousensis* as one species. They are all closely related but each has a definite range of its own. *C. plattensis* belongs to the sandy regions of Nebraska, Kansas, and northeastern Colorado; *C. Nelsonii*, as far as I know, is found only in Wyoming; *C. Tracyi* in southern Colorado; *C. brevifolius* in Wyoming and Montana; and *C. palousensis* in western Idaho and eastern Washington and Oregon. *Carduus Nelsonii* and *C. plattensis* are the most closely related of the four; the only difference I can find is that *C. plattensis* has the inner bracts prolonged into linear lanceolate, spreading, more or less crisp tip, a character not found in the rest. The characters given by Nelson in the key to distinguish *C. Nelsonii* and *C. plattensis* are useless, because the characters assigned to the latter are not true.

Under *Carduus filipendulus* (Engelm.) Rydb., in Coulter & Nelson's New Manual, are given as synonyms: *C. Flodmanii* Rydb. and *C. oblanceolatus* Rydb. The description of *C. filipendulus* is a verbatim copy of my description of *C. Flodmannii*. Little could be said against this, if the two were the same, but this is not the case. In the key, Professor Nelson distinguishes *C. filipendulus* from *C. undulatus*, *C. megacephalus*, and *C. ochrocentrus* by the characters: "Leaves becoming

green and glabrate on the upper side" against "Leaves permanently tomentose on both sides." The glabrate character is correct as far as *C. filipendulus* in concerned and was the reason why Dr. Gray associated it with *C. altissimus;* but it is not true of *C. Flodmanii*, for in that species the tomentum is as permanent as in *C. undulatus* and *C. ochrocentrus* and far more so than in *C. megacephalus*. In the key *C. filipendulus* is characterized, but the description is of *C. Flodmanii* under a wrong name. Dr. Gray included *C. Flodmanii* in his *Cnicus undulatus canescens*.

Professor Nelson has admitted a variety *Carduus undulatus canescens* (Nutt.) Porter. Evidently this was unknown to him for he simply copies Gray's characterization of *Cnicus undulatus canescens*. Some years ago, while visiting the Gray herbarium, I was curious to see what Gray meant by this variety. I found that it contained a mixture of *Carduus Flodmanii*, *C. oblanceolatus*, another related species of Arizona, and *Cirsium brevifolius* Nutt. The last is a yellow-flowered species related to *Carduus Nelsonii* and *C. plattensis*, and antedates both. Of these *C. Flodmanii* agrees best with the description of *Cirsium canescens* Nutt., and it might be that species. I have seen, however, a specimen of another species with strong erect involucral spines, which bore the name *Cirsium canescens* in Nuttall's own handwriting. Whether that specimen was the type or not I do not know, but I have adopted the name *Carduus canescens* for that species. Pammel in his treatise on the Iowa thistles adopted the name *Cnicus canescens* for *Carduus Flodmanii*. If Nelson had followed him, I would not have made any criticism, as there is some doubt as to which the name *canescens* belongs to, *C. Flodmanii* or the species for which I have adopted it.

Professor Nelson has also omitted all the Utah species described by Marcus E. Jones, although most of them belong to the range of the New Manual.

CENTAUREA and ARCTIUM

Neither of these two genera are included in the New Manual, although *C. Cyanus* has been collected at several places in Montana, *C. solstitialis* L. at Salt Lake City, Utah, and *A. minus* Schk. in Colorado.

NEW YORK BOTANICAL GARDEN.

Local flora notes—VII*

NORMAN TAYLOR

In order to hasten the completion of these notes it is planned to publish them monthly, either in Torreya or the BULLETIN. For the same reason they will hereafter be in tabulated form.

LORANTHACEAE

Species	*Specimens wanted from*
Razoumofskya pusilla (Peck) Kuntze.	Catskill region, northern N. J. and Pa.
Phoradendron flavescens (Pursh) Nutt.	Central and northern edge of pine-barrens in N. J.

ARISTOLOCHIACEAE

Asarum reflexum Bicknell.	Anywhere in the range.†

POLYGONACEAE

Rumex hastatulus Muhl.	New Jersey.
Rumex salicifolius Weinm.	Anywhere in the range.
Rumex verticillatus L.	N. Y. and Pa.
Rumex sanguineus L.	Near any city. Is it established?
Rumex pulcher L.	Near any city. Is it established?
Rumex conglomeratus Murr.	Near any city. Is it established?
Polygonum amphibium L.	Northern N. Y. and Pa.
Polygonum arifolium L.	Northern N. Y., N. J., and Pa.
Polygonum littorale Link.	S. I. and L. I., also N. J. coast.

*Continued from Torreya **10**: 224–228. O 1910.

†The local flora range as prescribed by the Club's Preliminary Catalogue of 1888 is as follows: All of the state of Connecticut; Long Island; in New York the counties bordering the Hudson River up to and including Columbia and Greene, also Sullivan and Delaware counties; all of New Jersey; and Pike, Wayne, Monroe, Lackawanna, Luzerne, Northampton, Lehigh, Carbon, Bucks, Berks, Schuykill, Montgomery, Philadelphia, Delaware, and Chester counties in Pennsylvania.

Species	*Specimens wanted from*
Polygonum dumetorum L.	Anywhere in the range.
Polygonum Hartwrightii A. Gray.	Central and southern N. J. and southeastern Pa.
Polygonum Rayi Babing.	Along any of the coasts.
CHENOPODIACEAE	
Chenopodium Boscianum Moq.	N. Y. and N. J.
Salicornia Bigelovii Torr.	Coast of N. J.
AMARANTACEAE	
Amaranthus pumilus Raf.	Coast of N. J.
Cladothrix lanuginosa Nutt.	Anywhere in the range.
PORTULACACEAE	
Claytonia caroliniana Michx.	Northern N. J. and Pa.
CARYOPHYLLACEAE	
Arenaria leptoclados Guss.	Along any of the coasts.
Arenaria groenlandica (Retz.) Spreng.	Northern N. Y., N. J., and Pa.
Arenaria Michauxii (Fenzl) Hook.	N. Y. and northern N. J.
Ammodenia peploides (L.) Rupr.	Coasts of Conn., L. I., S. I., and N. J.
Alsine borealis (Bigel.) Britton.	Northern N. J. and Pa.
Alsine pubera (Michx.) Britton.	N. J., and Pa. north of Bucks Co.
Cerastium semidecandrum L.	N. J., north of Atlantic Co.
Moenchia erecta (L.) Gaert.	Anywhere in the range.
Lychnis coronaria (L.) Desr.	L. I., Conn., and southern N. Y.
Silene virginica L.	N. Y. and Pa.
Silene alba Muhl.	N. J.
Silene antirrhina L.	N. Y., north of Westchester Co.
Silene dichotoma Ehrh.	Anywhere in the range.
Tunica Saxifraga (L.) Scop.	On L. I. or elsewhere.
Dianthus deltoides L.	Greene and Ulster Cos., N. Y., and Monroe Co., Pa.

NYMPHAEACEAE

Species	*Specimens wanted from*
Castalia tuberosa (Paine) Greene.	Anywhere in the range.
Nymphaea Kalmiana (Michx.) Sims.	Northern N. Y.
Nymphaea advena variegata (Engelm.) Fernald.	Northern N. Y., N. J., and Pa.
Nymphaea hybrida Peck.	Northern N. J. and Pa.
Nelumbo lutea (Willd.) Pers.	N. Y. and Pa.

MAGNOLIACEAE

Magnolia virginiana L.	Long Island.
Magnolia acuminata L.	Anywhere in the range.
Magnolia tripetala L.	Anywhere in the range.

ANONACEAE

Asimina triloba (L.) Durand.	N. Y. and N. J.

RANUNCULACEAE

Aconitum noveboracense A. Gray.	Orange, Greene, and Delaware Cos., N. Y.
Actaea rubra (Ait.) Willd.	N. J. and Pa.
Anemone riparia Fernald.	N. J.
Caltha radicans Forst.	Stations not in Britton's Manual.
Clematis ochroleuca Ait.	N. J.
Clematis Viorna L.	Southern Pa. and (?) N. J.
Coptis trifolia (L.) Salisb.	Below 500 ft. elevation anywhere.
Hepatica acuta (Pursh) Britton.	N. J. and Pa.
Hydrastis canadensis L.	Anywhere in the range.
Ranunculus pusillus Poir.	Pa.
Ranunculus alleghaniensis Britt.	Northern N. Y., N. J., and Pa.
Ranunculus pennsylvanicus L.	N. J. and Pa.
Batrachium trichophyllum (Chaix) F. Schultz.	Anywhere in the range.
Trollius laxus Salisb.	N. Y.
Xanthorrhiza apiifolia L'Hér.	Anywhere in the range.

Species	*Specimens wanted from*
Isopyrum biternatum (Raf.) T. & G.	Anywhere in the range.
BERBERIDACEAE	
Podophyllum peltatum L.	Northern N. J.
Jeffersonia diphylla (L.) Pers.	Anywhere in the range.
PAPAVERACEAE	
Sanguinaria canadensis L.	N. J., south of Middlesex and Mercer Cos.
FUMARIACEAE	
Bicuculla canadensis (Goldie) Millsp.	Northern N. J. and Pa.
Capnoides flavulum (Raf.) Kuntze.	Middle counties of N. J.
Capnoides aureum (Willd.) Kuntze.	Anywhere in the range.

NEW YORK BOTANICAL GARDEN.

INDEX TO AMERICAN BOTANICAL LITERATURE

(1910)

The aim of this Index is to include all current botanical literature written by Americans, published in America, or based upon American material; the word America being used in its broadest sense.

Reviews, and papers which relate exclusively to forestry, agriculture, horticulture, manufactured products of vegetable origin, or laboratory methods are not included, and no attempt is made to index the literature of bacteriology. An occasional exception is made in favor of some paper appearing in an American periodical which is devoted wholly to botany. Reprints are not mentioned unless they differ from the original in some important particular. If users of the Index will call the attention of the editor to errors or omissions, their kindness will be appreciated.

This Index is reprinted monthly on cards, and furnished in this form to subscribers, at the rate of one cent for each card. Selections of cards are not permitted; each subscriber must take all cards published during the term of his subscription. Correspondence relating to the card-issue should be addressed to the Treasurer of the Torrey Botanical Club.

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